localities, but it is not certain that they are economical or efficient.

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Nodular Worms of Sheep and Goats

REX W. ALLEN

SHEEP and goats harbor two species of nodular worms, the common nodular worm (*Oesophagostomum columbianum*) and the lesser nodular worm (*O. venulosum*).

The adult stages of both species live in the lower part of the digestive tract. They are whitish and about one-half inch long and one-fiftieth inch wide.

The common nodular worm causes the condition known as pimply gut, or knotty gut, in which growths—nodules—occur in the walls of the intestines.

Intestines of sheep are used in the meatpacking industry chiefly as casings for sausage and as material for surgical sutures. Intestines containing nodules are unsuitable for those uses.

The developmental cycle of the common nodular worm begins with the eggs that are produced by the adult female worms. The eggs pass out of infected animals in the manure. After a period of development, a small, immature worm—a first-stage larva—hatches from each egg. The larva grows into a second-stage and finally a third-stage larva.

The third stage is the infective stage. It is about one thirty-second inch long. It can develop further only in a susceptible animal, such as a sheep or goat. Development from the egg stage to the infective stage takes 6 or 7 days if the weather is favorable. Lower temperatures prolong the time or prevent development entirely.

In experiments conducted at Beltsville, Md., in 1945, A. G. Dinaburg found that mean air temperatures of 65° F. or above are necessary for their development. That means that in most parts of the United States little development takes place during winter.

The infective larvae are swallowed with feed or water. They penetrate the intestinal wall, usually in the lower part of the small intestine. After about 5 days, the larvae have attained a length of about one-twelfth inch. Now they migrate out of the wall into the lumen, the hollow part of the intestine, where growth to the adult stage takes place. Infective larvae usually reach the adult stage in 4 to 8 weeks.

The lesser nodular worm develops in much the same way.

Nodules, which often are as big as a pea, form as a direct result of penetration of the intestinal wall by the larval worms. Nodules are sites where

larvae become encapsulated, or walled off, as the tissues of the affected animal try to ward off the encroachment of the parasites.

The common nodular worm is responsible for retarded growth, reduced weights of pelts and organs, a lower dressing-out percentage, and poor quantity and quality of wool. These effects are due mainly to the nodules and the penetration of the intestinal wall by the immature worms rather than to the adult stages of the parasite. The adults may cause diarrhea, increased secretion of mucus, and slight anemia.

Nodules are sometimes so numerous as to form a firm, tumorlike mass. There is a scarring, hardening, and thickening of the intestinal wall. Such extensive involvement undoubtedly interferes with the digestion and absorption of food.

The effects of the lesser nodular worm are less serious. It causes diarrhea and has some effect on gains in weight.

Symptoms of nodular worm disease include loss of appetite and loss of weight. The wool becomes dry, brittle, and yellow; it is often soiled because of a chronic diarrhea. Affected animals are weak and assume a hunched-up posture. Rectal temperature may rise slightly. Often a slight anemia follows.

Diagnosis on the basis of symptoms is complicated by the fact that some other worm parasites cause symptoms similar to those of nodular worm disease. It is hard to identify the eggs of the nodular worm because they look like some of the other worm eggs. But a slight anemia and the presence in the manure of a large number of eggs of typical size and shape is indicative, particularly if diarrhea is present.

Nodules can be detected in some cases in the wall of the rectum by feeling with the finger. A presumptive diagnosis may be made in this way. Postmortem examination reveals the typical nodules as well as the adult worms.

MEDICINAL TREATMENT is an effective weapon against nodular worm disease.

A single dose of phenothiazine, the drug of choice, will remove a high percentage of the adult worms from affected animals and so cut down the source of new infection.

Medicinals have no effect on nodules, however, and animals suffering from nodules cannot be expected to recover promptly.

Good sanitation practices aid materially in the control of nodular worms. The more heavily contaminated a pasture becomes, the more dangerous it is as a source of nodular worms. Much is to be gained therefore by shifting flocks occasionally from one pasture to another. This practice reduces the amount of contamination and the risks of infection as well.

Overstocking and overgrazing invite nodular worm disease.

CONTROL MEASURES that combine good sanitation and medicinal treatment and are carried out in the light of present knowledge concerning the seasonal development of nodular worms and their free-living stages will go far in abating this widespread parasitic disease.

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For further reading:

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